

III. AMENDMENTS TO THE CLAIMS

1. (Currently amended) A method of determining characteristics of samples comprising:

- [[a.]] building algorithms of the relationship between sample characteristics and absorbed and scattered light from a sample having an interior;
- [[b.]] illuminating the interior of a sample with a frequency spectrum;
- [[c.]] detecting the spectrum of absorbed and scattered light from the sample;
- [[d.]] analyzing the detected spectrum of absorbed and scattered light from the sample with the algorithms; calculating the characteristics of the sample.

2. (Currently amended) The method of claim 1 further comprising:

- [[a.]] building the algorithms to generate a regression vector that relates a VIS and NIR spectra to brix, firmness, acidity, density, pH, color and external and internal defects and disorders;
- [[b.]] storing the regression vector, in a CPU having a memory, as a prediction or classification calibration algorithm;
- [[c.]] illuminating the sample interior with a spectrum of 250 to 1150nm;
- [[d.]] inputting the detected spectrum of absorbed and scattered light from the sample interior to a spectrometer;
- [[e.]] converting the detected spectrum from analog to digital and inputting the converted spectrum to a CPU; combining the spectrum detected;
- [[f.]] comparing the combined spectrum with a stored calibration algorithm;
- [[g.]] predicting the characteristics of the sample.

3. (Currently amended) The method of claim 1 further comprising:

- [[a.]] the characteristics are chemical characteristics including acidity, pH and

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on June 8, 2004 by Floyd E. Ivey,
Serial No. 09/804,613
Floyd E. Ivey, USPTO 35552,

Application No. 09/804,613

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1 sugar content

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3 4.(Currently amended)The method of claim 1 further comprising:

4 [[a.]] the characteristics are physical characteristics including firmness, density,
5 color, appearance and internal and external defects and disorders.

6 5.(Currently amended) The method of claim 1 further comprising:

7 [[a.]] the characteristics are consumer characteristics.

8 6.(Currently amended)The method of claim 1 further comprising:

9 [[a.]] sampling samples from the group of C-H, N-H or O-H chemical groups;

10 [[b.]] illuminating of the interior of the sample is with a frequency spectrum
11 including visible and near infrared light;

12 [[c.]] building algorithms for a correlation analysis separately of Brix, firmness,
13 pH and acidity in relation to the light spectrum output from the illuminated sample;

14 [[d.]] detecting the spectrum of absorbed and scattered light from the sample with
15 a light detector.

16

17 7.(Currently amended)The method of claim 2 further comprising:

18 [[a.]] illuminating of the interior of the sample with a frequency spectrum of 250
19 to 1150 nm;

20 [[b.]] detecting the spectrum of absorbed and scattered light from the sample with
21 at least one light detector; the at least one light detector comprising at least one light
22 detector fiber; shielding the at least one light detector fiber from the illuminating
23 spectrum;

24 [[c.]] measuring the spectrum for chlorophyll at around 680 nm;

25 [[d.]] correlating the characteristics of Brix, firmness, pH and acidity with the

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1 measured spectrum.

2
3 8.(Cancelled)

4
5 9.(Currently amended) ~~The apparatus of claim 8 further comprising:~~ An apparatus to
6 predict characteristics of a sample comprising:

7 at least one light source; a sample having an sample surface and an interior; input
8 mechanism of positioning the at least one light source proximal the sample surface;

9 at least one light detector; output mechanism of positioning the at least one light
10 detector proximal the sample surface;

11 at least one mechanism of measuring the illumination detected from the sample;

12 [[a.]] the at least one light source produces a spectrum within the range of 250 to
13 1150 nm;

14 [[b.]] the at least one mechanism of measuring the illumination is a spectrometer;
15 the spectrometer has at least one input;

16 [[c.]] ~~the at least one light detector is a light pickup fiber;~~ the at least one light
17 detector collects a spectrum which is received by the at least one spectrometer input;

18 the spectrometer has at least one spectrometer output channel; a CPU having at
19 least one CPU input; the at least one CPU input receiving the at least one spectrometer
20 output; at least one computer program; the CPU is controlled by the at least one computer
21 program; the CPU having at least one CPU output; the at least one computer program
22 causing the at least one CPU output to perform the steps of 1) calculation of absorbance
23 spectra (173) occurs for each at least one spectrometer output channel 1...n, 2) combine
24 absorbance spectra (174) into a single spectrum encompassing the entire wavelength
25 range detected from the sample by spectrometers 1...n (170), 3) mathematical

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1 preprocessing or preprocess (175), by smoothing or box car smooth or calculate
2 derivatives, precedes 4) the prediction or predict (176), for each at least one spectrometer
3 output channel, comparing the preprocessed combined spectra (175) with at least one
4 stored calibration spectrum or at least one calibration algorithm(s) (177) for each sample
5 characteristic 1...x (178), comprising brix, firmness, acidity, density, pH, color and
6 external and internal defects and disorders, for which the sample is examined, followed
7 by 5) decisions or further combinations and comparisons of the results of quantification
8 of each characteristic, 1...x, comprising determination of internal and or external defects
9 of disorders (179), (180); determination of color (181); determination of indexes of
10 eating quality index [[182]] (182), appearance quality index (183) and concluding
11 with sorting or other decisions (184); 6) sorting or other decisions (184) may be input
12 process controllers to control packing/sorting lines or may determine the time to harvest,
13 time to remove from cold storage, and time to ship;

14 [[d.]] the sample is from the chemical group of C-H, N-O, and O-H.

15
16 10. (Currently Amended) The apparatus of claim 9 further comprising:

17 [[a.]] the at least one spectrometer output are converted from analog to digital by at least
18 one A/D converter which become, for each at least one spectrometer output channel, input to at
19 least one CPU input; the at least one CPU output provided for each at least one spectrometer
20 output channel 1....n.; the at least one light detector is a light pickup fiber.

21
22 11. (Currently Amended) The apparatus of claim-8- 9 further comprising:

23 [[a.]] the least one light source is a tungsten halogen lamp; the illumination is
24 transmitted to the sample surface by fiber optics;

25 [[b.]] the at least one light detector is a fiber optics light pickup;

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1 [[c.]] the at least one spectrometer comprises a 1026 linear array detector;

2
3 12. (Currently amended) The apparatus of claim 9 further comprising:

4 [[a.]] the at least one light source is at least one illumination fiber.

5
6 13. (Currently amended) The apparatus of claim ~~8~~ 9 further comprising:

7 [[a.]] an at least one light source comprises a plurality of illumination fibers;

8 [[b.]] the plurality of illumination fibers are arrayed such that each illumination fiber is
9 equidistant from adjoining illumination fibers; the at least one light detector is positioned
10 centrally in the array of illumination fibers.

11
12 14. (Currently amended) The apparatus of claim 12 further comprising:

13 [[a.]] the at least one light source is a plurality of illumination fibers comprised of 32
14 illumination fibers.

15
16 15. (Currently amended) The apparatus of claim 9 further comprising:

17 [[a.]] the at least one light source is a 5w tungsten halogen lamp.

18
19 16. (Currently amended) The apparatus of claim 9 further comprising:

20 [[a.]] the at least one light sources is comprised of two 50 w light sources;

21 [[b.]] the at least one light detector is comprised of a plurality of light detectors.

22
23 17. (Currently amended) The apparatus of claim ~~15~~ 9 further comprising:

24 [[a.]] the at least one light source is a plurality of light detectors sources arrayed such
25 that each light detector source is equidistant from adjoining light detectors.

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2 18. (Currently amended) The apparatus of claim 16 further comprising:

3 [[a.]] the at least one light detector is a plurality of light detectors comprising twenty-
4 two light detectors.

5
6 19. (Currently amended) The apparatus of claim 11 further comprising:

7 [[a.]] the at least one light source comprised of an ellipsoidal reflector having a
8 50 w bulb with cooling fan; the transmission of the illumination to the sample surface at
9 least one light source is a plurality of illumination fibers comprised of at least one two
10 fiber optic fiber for transmission of the light source to the sample surface.

11 [[b.]] the at least one two fiber optic and the at least one light detector spring
12 biased against the sample surface; the pressure exerted by the spring biasing limited by
13 the character of the sample.

14
15 20. (Currently amended) The apparatus of claim 11 further comprising:

16 [[a.]] the at least one light source is a 5 w tungsten halogen lamp; the at least one light
17 detector is a single fiber optic fiber; the light source is positioned against the sample surface 180
18 degrees distal to the detection fiber.

19
20 21. (Currently amended) The apparatus of claim 12 further comprising:

21 [[a.]] a polarization filter is positioned between the at least one light source and the
22 sample;

23 [[b.]] a matching polarization filter is positioned between the at least one light detector
24 and the sample.

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1 22. (Currently amended) The apparatus of claim 21 further comprising:

2 [[a.]] the polarization filter is a linear polarization filter; the matching polarization filter
3 is a linear polarization filter rotated 90 degrees in relation to the polarization filter.
4

5 23. (Currently amended) An apparatus to predict characteristics of a sample:

6 [[a.]] at least one light source; a sample having a sample surface and an interior;
7 input mechanism of positioning the at least one light source proximal the sample surface;
8 at least one shutter intermediate the at least one light source and the sample; the at least
9 one light source having a lamp output;

10 [[b.]] at least one light detector; output mechanism of positioning the at least one
11 light detector proximal the sample surface; at least one collimating lens intermediate the
12 at least one light detector and the sample surface; at least one mechanism of measuring
13 the illumination detected from the sample surface;

14 [[c.]] at least one reference light detector directed to the lamp output; at least one
15 shutter intermediate the at least one reference light detector and the at least one lamp
16 output; at least one mechanism of measuring the illumination detected from the lamp
17 output.
18

19 24. (Currently amended) The method of claim 2 further comprising:

20 [[a.]] using the predicted characteristics of the sample in combination as follows: using
21 the ratio of the sugar content to acid content to better predict eating quality, taste, sweet/sour
22 ratio; using the combined data from two or more of the following: sugar content, acid content,
23 pH, firmness, color, external and internal disorders to better predict eating quality.
24

25 25. (Currently amended) The method of claim ~~2~~ 24 further comprising:

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1 [[a.]] sensing sample data including sensing by sample presence sensing means the presence or
2 absence of a sample conveyed on a sample conveyor while in motion; sensing by sample position
3 sensing means the position/location of the sample [[30]] (30) relative to the point of
4 spectrum measurement; presence sensing means and position sensing means having outputs to a
5 computer program controlled CPU; the computer program controlled CPU determining if the
6 sample [[30]] (30) being measured is at the optimal location(s) for spectrum measurement;
7 the computer program controlled CPU determining if a sample is present.

8
9 26. (Currently amended) The method of claim 25 further comprising:

10 [[a.]] presence sensing means is a proximity sensing means.

11
12 27. (Currently amended) The method of claim 26 further comprising:

13 [[a.]] position sensing means is an encoder or pulse generator (330) detecting sample conveyor
14 (295) movement and providing one or more electronic or digital signals to a CPU (172) which
15 initiates, by computer program control, control signals to initiate and stop acquisition of spectra.

16
17 28. (Currently amended) The method of claim 27 further comprising:

18 [[a.]] determining by computer program controlled CPU timing for performing reference testing
19 of light source lamp, spectrometer performing of reference testing of light source lamps and of
20 spectrometer receiving spectra input from detectors.

21
22 29. (Currently amended) The method of claim 28 further comprising:

23 [[a.]] testing of reference including measurement of dark spectra and/or reference spectra and/or
24 standard/calibration samples.

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2 30. (Currently amended) The method of claim 29 further comprising:

3 [[a.]] light source lamp light collection achieved using a collimating lens (78) and or other light
4 transmission means including fiber-optics to transfer the light that has interacted with the sample
5 (30) to the spectrometer(s) (170) detectors (200); if no sample (30) is present, other reference
6 measurements are made to improve stability and accuracy such as previously mentioned dark
7 spectra, reference spectra (lamp intensity and color output), and standard/calibration samples,
8 which may be optical filters or polymers or organic material with known and repeatable spectral
9 characteristics; measurements that are made when no sample is present include, but are not
10 limited to 1) measuring a reference spectrum (intensity vs. wavelength) of the light source(s), 2)
11 measuring the dark current (no light conditions) of one or more spectrometer(s) (170) detector(s)
12 (200), including but not limited to the sample spectrometer(s) (170) and the reference
13 spectrometer(s) (170), and 3) standard or calibration samples or filters (130) or material.
14

15 31. (Currently amended) The apparatus of claim ~~8~~ 9 further comprising:

16 [[a.]] sample presence sensing means for sensing of the presence or absence of a sample
17 conveyed on a sample conveyor while in motion; sample position sensing means of the
18 position/location of the sample (30) relative to the point of spectrum measurement; presence
19 sensing means and position sensing means having outputs to a computer program controlled
20 CPU; the computer program controlled CPU determining if the sample (30) being measured is
21 at the optimal location(s) for spectrum measurement; the computer program controlled CPU
22 determining if a sample is present.
23

24 32. (Currently amended) The apparatus of claim 31 further comprising:
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1 [[a.]] presence sensing means is a proximity sensing means.

2

3 33. (Currently amended) The apparatus of claim 32 further comprising:

4 [[a.]] position sensing means is an encoder or pulse generator (330) detecting sample conveyor
5 (295) movement and providing one or more electronic or digital signals to a CPU (172) which
6 initiates, by computer program control, control signals to initiate and stop acquisition of spectra.

7

8 34. (Currently amended) The apparatus of claim 33 further comprising:

9 [[a.]] computer program controlled CPU timing for performing reference testing of light source
10 lamp, spectrometer performing of reference testing of light source lamps and of spectrometer
11 receiving spectra input from detectors.

12

13 35. (Currently amended) The apparatus of claim 34 further comprising:

14 [[a.]] reference testing including measurement of dark spectra and/or reference spectra and/or
15 standard/calibration samples.

16

17 36. (Currently amended) The apparatus of claim 35 further comprising:

18 [[a.]] light source lamp light collection achieved using a collimating lens (78) and or other light
19 transmission means including fiber-optics to transfer the light that has interacted with the sample
20 (30) to the spectrometer(s) (170) detectors (200) if no sample (30) is present, other reference
21 measurements are made to improve stability and accuracy such as previously mentioned dark
22 spectra, reference spectra (lamp intensity and color output), and standard/calibration samples,
23 which may be optical filters or polymers or organic material with known and repeatable spectral
24 characteristics measurements that are made when no sample is present include, but are not
25

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1 limited to 1) measuring a reference spectrum (intensity vs. wavelength) of the light source(s), 2)
2 measuring the dark current (no light conditions) of one or more spectrometer(s) (170) detector(s)
3 (200), including but not limited to the sample spectrometer(s) (170) and the reference
4 spectrometer(s) (170), and 3) standard or calibration samples or filters (130) or material.

5
6 37. (Currently amended) The method of claim 2 further comprising:

7 [[a.]] measuring by reference measurement changes in light source lamp intensity or color
8 output, a reference spectrometer output and output of spectrometer receiving sample spectra
9 input from detectors; transmitting light from light source lamps to the reference spectrometer
10 with detector using a reference light transmission means.

11
12 38 (Currently amended) The method of claim 37 further comprising:

13 [[a.]] using fiber-optics as the reference light transmission means.

14
15 39. (Currently amended) The method of claim 37 further comprising:

16 [[a.]] using a light pipe as the reference light transmission means.

17
18 40. (Currently amended) The method of claim 37 further comprising:

19 [[a.]] positioning the reference light transmission means, at the light source lamp, to allow only
20 light from the light source lamp to enter the reference light transmission means.

21
22 41. (Currently amended) The method of claim 40 further comprising:

23 [[a.]] placing at least one light shutter intermediate each light source lamp and each reference
24 light transmission means; opening and closing the at least one light shutter by shutter control

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1 means.

2

3 42. (Currently amended) The method of claim 37 further comprising:

4 [[a.]] measuring, by the reference spectrometer, each light source lamp separately; inputting the
5 reference spectrometer output to the computer controlled CPU; storing in the CPU intensity vs.
6 wavelength spectrum profile for each light source lamp; comparing the stored intensity vs.
7 wavelength spectrum with the reference spectrometer output; determining from the comparison
8 the condition of the light source lamp.

9

10 43. (Currently amended) The method of claim 2 further comprising:

11 [[a.]] using the detected spectrum as a reference spectrum, for purposes of calculating an
12 absorbance (or log 1/R) spectrum, which is linear with concentration.

13

14 44. (Currently amended) The method of claim 41 further comprising:

15 [[a.]] closing all of the light shutters of the reference light transmission means; allowing a dark
16 current (no light condition) measurement of the spectrometer (170) detector(s) (200); measuring
17 the dark current and its intensity value at each wavelength (or detector) pixel; subtracting the
18 measured dark current from a reference spectrum obtained with the shutters (330) open.

19

20 45. (Currently amended) The method of claim 37 further comprising:

21 [[a.]] measuring a reference spectrometer output and a sample spectrometer output dark
22 current; shielding by shielding means, the input to the reference spectrometer and the
23 input to the sample spectrometer; inputting the reference spectrometer output and the
24 sample spectrometer to the computer controlled CPU; subtracting the output measured

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1 from the reference spectrometer; subtracting the output measured from the sample
2 spectrometer.

3
4 46.(Currently amended) The apparatus of claim-8- 9 further comprising:

5 [[a.]] at least one light detector (80) having at least one output (82) to at least one
6 spectrometer (170) having at least one detector (200); at least one colluminating lens (78)
7 intermediate the at least one light detector (80) and a sample (30); the at least one light
8 detector (80) positioned to detect light from the sample (30); at least one light source
9 (120) lamp (123); a light shielding means intermediate the at least one light source (120)
10 lamp (123) and a sample (30); at least one aperture (310) in the light shielding means to
11 allow illumination of the sample (30) by the at least one light source (120) lamp (123); at
12 least one light interruption means intermediate the at least one light source (120) lamp
13 (123) and the at least one aperture (310); the at least one light interruption means operable
14 by at least one light interruption control means; the at least one light interruption control
15 means receiving control signals from at least one CPU (172) having at least one light
16 interruption operating control output; at least one reference light transmitting means
17 receiving reference light output from the at least one light source (120) lamp (123); at
18 least one reference light interruption means intermediate the at least one light source
19 (120) lamp (123) and the at least one reference light transmitting means; the at least one
20 reference light interruption means operable by at least one reference light interruption
21 means control means; the at least one reference light interruption means control means
22 (305) receiving control signals from at least one CPU (172) having at least one reference
23 light interruption operating control output (307); the at least one reference light
24 transmitting means (81) providing an input to the at least one spectrometer (170) detector
25

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(200); the at least one CPU (172) providing at least one lamp power output (125) to the at least one light source (120) lamp (123); the at least one spectrometer (170), receiving input from at least one reference light transmitting means (81) having at least one output (82) received as input to the at least one CPU (172); the spectrometer output (82) capable of A/D conversion to form input to the at least one CPU (172); the at least one spectrometer (170), receiving input from at least one detector output (82) received as input to the at least one CPU (172); the spectrometer output (82) capable of A/D conversion to form input to the at least one CPU (172); mounting means to mount light sources (120) lamps (123), detectors (80), light interruption means including shutters (300), shutter control means (305), reference light transmitting means (81) and case (250); encoder/pulse generator (330) input to CPU (172) providing sample conveyor (295) movement data; computer program to operate CPU (172) in data collection and control functions.

47. (Currently amended) The method of 37 further comprising:

[[a.]] measuring, as a reference measurement, the light source (120) lamp(s) (123) intensity vs. wavelength output using reflecting means (360); positioning reflecting means (360) to reflect light from light source lamps to a light detector having a light detector output which is received by a spectrometer detector.

48. (Currently amended) The method of 47 further comprising:

[[a.]] positioning the reflecting means, by reflection position means, to a position to reflect light from light source lamps to a light detector as dictated by reflecting control means (308), as an output from a CPU (172), controlling the reflection position means; the

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1 CPU (172), via means, detecting the presence or absence of a sample (30) and, when a
2 reference measurement is to be made, inserting the reflecting means as dictated by
3 reflecting control means (308) controlling the reflection position means as an output from
4 a computer program controlled CPU (172); withdrawing the reflecting means as dictated
5 by reflecting control means (308) controlling the reflection position means as an output
6 from a computer program controlled CPU (172).

7
8 49. (Currently amended) The apparatus of claim-~~8~~ 9 further comprising:
9 [[a.]] reflecting means, positioned by reflection position means, to a position to reflect
10 light from light source lamps to a light detector as dictated by reflecting control means
11 (308), as an output from a CPU (172), controlling the reflection position means; the CPU
12 (172), via means, detecting the presence or absence of a sample (30) and, when a
13 reference measurement is to be made, inserting the reflecting means as dictated by
14 reflecting control means (308) controlling the reflection position means as an output from
15 a computer program controlled CPU (172); withdrawing the reflecting means as dictated
16 by reflecting control means (308) controlling the reflection position means as an output
17 from a computer program controlled CPU (172).

18
19 50 (Currently amended) The apparatus of claim-~~8~~ 9 further comprising:
20 [[a.]] a light reflecting or diffusing body for obtaining the reference spectrum may also
21 be obtained by mechanical insertion of reference means (430), in or near the location
22 where actual sample (30) is normally measured, which is between the light source (120)
23 lamp(s) (123) and reference light transmission means (320) leading to the sample
24 spectrometer (170) detector (200)(s); insertion is by insertion means including but not
25

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1 limited to an actuator system (400) capable, upon receiving control signals or means
2 including control signals or means provided from a CPU (172), of operation of an
3 actuator (410) causing a piston (420) to extend (421) and retract (422); power, including
4 electrical, pneumatic, hydraulic and other means, is provided to operate the actuator by
5 power transmission means (440).

6
7 51. (Currently amended) The method of claim 2 further comprising:
8 [[a.]] illuminating, with at least one light source lamp, the sample interior while the
9 sample is rolling or revolving, where a rolling measurement generally improving whole
10 product measurement.

11
12 52. (Currently amended) The method of claim 2 further comprising:
13 [[a.]] illuminating, with at least one light source lamp, the sample interior while the
14 sample is not rolling or revolving, where a non-rolling measurement provides better
15 accuracy and introduces less spectral noise due to movement.

16
17 53.(Currently amended) The method of claim 2 further comprising:
18 [[a.]] obtaining, as a sample (30) passes by the point of spectrum acquisition, multiple
19 spectra, where each spectrum representing a different measurement location or area on
20 the product.

21
22 54.(Currently amended) The method of claim 2 further comprising:
23 [[a.]] optimizing signal-to-noise and accuracy with small and large samples by 1)
24 determining the size or weight of the sample by weight or mass sensors ~~common to the~~
25

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28 on June 8, 2004 by Floyd E. Ivey,
Serial No. 09/804,613

Application No. 09/804,613

Floyd E. Ivey, USPTO 35532,

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1 industry; 2) utilizing a color sorter or defect sorter to provide data; 3) utilizing other size
2 sensors based on magnetic, inductive, light reflectance or multiple light beam curtains;
3 common to other industries.

4
5 55. (Currently amended) The method of claim 54 further comprising:

6 [[a.]] adjusting, in accordance with the relative size of the sample, the hardware spectrum
7 acquisition parameters or the amount of light by varying an aperture (310) size, to
8 provide an improved signal-to-noise ratio spectrum for large samples (30) and/or to
9 prevent detector (80) saturation by light for small product sample (30) detector (80)
10 exposure or integration time can be set for longer time periods for large product samples
11 (30) and for shorter time periods for small product.

12
13 56. (Currently amended) The method of claim 2 further comprising:

14 [[a.]] improving accuracy by inspection of multiple individual spectra collected from a
15 single sample; removing poor quality or "outlier" spectra; calculating the absorbance
16 spectrum from the raw data collected for dark, reference and sample; inspecting each
17 individual spectrum from the series or batch of spectra acquired for each individual
18 product sample by a computer program controlled CPU or by programmed hardware;
19 deleting poor quality spectra from this batch of spectra, using the remaining spectra for
20 constituent or property prediction; combining the retained spectra of the product sample
21 with the appropriate reference and dark current measurements to produce an absorbance
22 spectrum as follows: absorbance spectrum = $-\log_{10} [(sample\ intensity\ spectrum - sample\ dark\ current\ spectrum) / (reference\ intensity\ spectrum - reference\ dark\ current\ spectrum)]$
23 i.e. the absorbance spectrum is equal to the negative logarithm (base 10) of the ratio of
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1 the dark current corrected sample spectrum to the dark current corrected reference
2 spectrum.

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4 57. (Currently amended) The method of claim 56 further comprising:

5 [[a.]] combining all of the absorbance spectra for each product sample to produce a mean
6 or average absorbance spectrum of the product sample; using this average absorbance
7 spectra to compute the sample component, characteristic or property of interest based on a
8 previously stored calibration algorithm.

9
10 58. (Currently amended) The method of claim 56 further comprising:

11 [[a.]] using each absorbance spectrum individually with the previously stored
12 calibration algorithm to compute multiple results of the sample component, characteristic
13 or property of interest for an individual product sample; determining the average or mean
14 component, characteristic or property of interest by summing all of the values and
15 dividing the resultant sum by the number of absorbance spectra used.

16
17 59. (Currently amended) The method of claim 2 further comprising:

18 [[a.]] measuring samples and linking location on product sample where visible/NIR data was
19 collected with the same location that will be measured by the laboratory reference technique;
20 calibrating performed as follows: 1) measuring spectra of product sample (30) and measuring
21 absorbance spectra; correcting for reference and dark current and storing measurements; 2)
22 undertaking standard laboratory measurements on the product sample (30); observing that it is
23 important to the success of the NIR method that the portion of the sample (30) that is
24 interrogated between the light source(s) (120) lamps (123) and light collection(s) detectors, e.g.,
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1 light detectors (80), leading to the spectrometer(s) (170) detectors (200) is the same as that
2 portion measured by the standard laboratory technique.

3
4 60. (Currently amended) The method of claim 59 further comprising:

5 [[a.]] transporting samples, by a sample conveyors (295), to the NIR measurement location
6 including to a light detector; selecting rolling or not rolling sample conveyor (295) means; where
7 rolling analyzing the entire sample for the component, characteristic or property of interest;
8 averaging, if calibration algorithms are constructed in this way (using measurements of rolling
9 product), all of the retained spectra for that individual product to produce an average absorbance
10 spectrum and the total product component or property is assigned to this one absorbance
11 spectrum.

12
13 61. (Currently amended) The method of claim 59 further comprising:

14 [[a.]] transporting samples, by a sample conveyor (295), to the NIR measurement location
15 including to a light detector; selection not rolling sample conveyor (295) means; performing
16 laboratory measurements on the same portion of product sample (30) that spectra were taken
17 from; determining whether to separate a sample into smaller sub-portions prior to laboratory
18 analysis; adjusting the time period of NIR data acquisition to shorter or longer times,
19 corresponding to the measurement of smaller or larger product samples (30), respectively;
20 associating, with each sub-portion of the product sample (30), one or more spectra associated
21 with that particular location; assigning the laboratory determined component, characteristic or
22 property of interest to each spectrum or spectra from that particular location.

23
24 62. (Currently amended) The method of claim 2 further comprising:

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1 [[a.]] performing mathematical processing on absorbance spectra prior to conducting
2 statistical correlation analysis and calibration model building; pre-processing absorbance
3 spectra using a bin and smooth function; relating by Partial least squares analysis (or
4 variants thereof such as piecewise direct standardization) the processed absorbance
5 spectrum to the assigned component and property values such as Brix, acidity, pH,
6 firmness, color, internal or external disorder severity and type, and eating quality.

7
8 63. (Currently amended) The method of claim 2 further comprising:

9 [[a.]] minimizing the number of samples needed to develop a calibration model;
10 collecting spectra on all test samples; performing, prior to destructive laboratory
11 measurements, principal components analysis (PCA) on the absorbance spectra;
12 generating Resultant Score plots from PCA (~~e.g., Score 1 vs. Score 2, Score 3 vs. Score 4,~~
13 ~~etc.~~); selecting a subset of the original samples (~~e.g., 40% of the original number of~~
14 ~~samples~~) from the Score plots in either a random fashion or by selecting samples that, as a
15 group, yield a similar range, mean and standard deviation of score values compared to the
16 entire group of original samples (30).

17
18 64.(Currently amended) The method of claim 63 further comprising:

19 [[a.]] periodically requiring calibration updates to maintain measurement accuracy;
20 minimizing the efforts of calibration updates; analyzing, as fruit or vegetable samples are
21 in a packing and sorting warehouse, the visible/near infrared spectra; examining by
22 computer program controlled CPU, and determining if the sample qualifies as a potential
23 calibration update sample; selecting calibration update samples (30) which cover low to
24 high component values and which have Score values that cover the same range as the
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1 original sample's (30) Score values.
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